here published, and the text is supplemented by twenty-seven full-page illustrations.—J. M. GREENMAN.

Handbook of deciduous trees.—The ninth part[10] of SCHNEIDER'S *Handbook* (the fourth section of the second volume) has followed the preceding one[11] with great promptness. As already noted, it presents descriptions of the species of angiospermous trees, native or under cultivation in central Europe, and is illustrated freely. The present part begins with Tilia and ends with Rhododendron. —J. M. C.

NOTES FOR STUDENTS

Morphology of Tumboa.—Three years ago PEARSON published[12] the results of his investigation of Tumboa (Welwitschia) from material obtained in one day's collecting. A second expedition to Damaraland was made possible and material was collected during January and February of 1907, the results of the investigation of which are now published.[13] The additional stages thus secured have put our knowledge of this most interesting plant upon a fairly substantial basis, and PEARSON is to be thanked for his persistent enthusiasm in securing this difficult material. An outline of what seem to be the most significant new results is as follows:

The staminate and ovulate strobili are often produced in great profusion and their occurrence below the single pair of leaves is frequent. Pollination is mainly effected by a hemipterous insect (Odontopus), the pollen being received by a nectar drop on the top of the projecting micropylar tube. The pollen grains frequently germinate in the micropyle at some distance from the tip of the nucellus, the tube growing down through the fluid which fills the micropyle at the time of pollination. The generative cell passes into the tube, where its nucleus divides, the binucleate cell either remaining undivided or forming two male cells. The tube nucleus begins to break down before fertilization and eventually disappears.

The most critical and puzzling structure of Tumboa, however, is the embryo sac. Megaspores and embryo sacs are often present in the pith region of the axis of the ovulate strobilus, so that the cauline origin of the ovule is clear. A single megaspore mother cell is organized and a single megaspore functions. The female gametophyte begins with free nuclear division and no vacuolation, and successive simultaneous divisions occur until there are approximately 1024 free and crowded nuclei. Elongation of the sac then occurs, chiefly in its micropylar

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[10] SCHNEIDER, C. K., Illustriertes Handbuch der Laubholzkunde. Neunte Lieferung (vierte Lieferung des zweiten Bandes). Imp. 8vo. pp. 367–496. *figs. 249–328.* Jena: Gustav Fischer. 1909. *M* 4.

[11] BOT. GAZETTE **47**:415. 1909.

[12] PEARSON, H. H. W., Some observations on *Welwitschia mirabilis* Hooker. Phil. Trans. Roy. Soc. London B **198**:265–304. *pls. 18–22.* 1906. Review in BOT. GAZETTE **42**:67. 1906.

[13] ———, Further observations on Welwitschia. Phil. Trans. Roy. Soc. London B **200**:331–402. *pls. 22–30.* 1909.

fourth, so that the outer nuclei are more widely separated than the rest. These more scattered nuclei are sexually functional, while the more crowded ones in the inner three-fourths of the sac give rise to the endosperm. Incomplete wall-formation occurs, dividing the sac into irregular and multinucleate compartments, those of the upper fourth usually containing not more than six nuclei, while those of the lower three-fourths contain twelve or more nuclei. The outer multinucleate cells develop tubular prolongations (prothallial tubes) into the nucellus, into which the nuclei and most of the cytoplasm pass. Occasionally these sexual nuclei fuse within the prothallial tube. In the multinucleate cells of the inner three-fourths of the sac the nuclei seldom divide, but all fuse, forming uninucleate cells. This endosperm, consisting of uninucleate cells whose nuclei are formed by the fusion of what the author regards as potential gametes, he calls a *trophophyte*, to distinugish it from both gametophyte and sporophyte, and says that it "differs fundamentally from the prothallus of the lower gymnosperms," a statement which will have to be amended in a way that will make the proposed name seem unnecessary.

When connection is established between the tip of a pollen tube and of a prothallial tube, "the leading female nucleus enters the generative cell within which fertilization occurs," which is certainly a remarkable performance.

In embryo-formation, the fertilized egg elongates to form a proembryonal tube, toward the tip of which the nucleus moves and divides, when a tip cell is cut off by an ingrowing wall, just as in Gnetum. The tubular cell of the proembryo continues to elongate, while the tip cell develops the embryo, which consists of about sixty cells when its tip reaches the endosperm.

The author enters into a somewhat extended discussion of the general bearings of the facts he has uncovered, a discussion which will be considered in another connection.—J. M. C.

Mechanism of photeolic movements.—LEPESCHKIN, whose investigations of turgor mechanisms have been already extensive and important, has added a study of the mechanism concerned in the so-called sleep movements of leaves, which he designates as photonastic.[14] (It seems to the reviewer much better to reserve the terms compounded of *-nastic* for the irreversible movements due to growth. As an equivalent of the cumbrous *Variationsbewegungen* eolic movements may be suggested. Long since[15] I proposed for the sleep movements the term photeolic movements, avoiding thus the false implications of sleep, nyctitropic, and photonastic.) Without referring to the divergent views of various authors on which his

[14] LEPESCHKIN, W. W., Zur Kenntnis des Mechanismus der photonastischen Variationsbewegungen und der Einwirkung des Beleuchtungswechsels auf die Plasmamembran. Beih. Bot. Centralbl. **24**:308–356. 1909. Preliminary paper: Zur Kenntnis des Variationsbewegungen. Ber. Deutsch. Bot. Gesells. **26a**:724–735. 1908.

[15] HEALD, F. D., Contribution to the comparative histology of pulvini and the resulting photeolic movements. BOT. GAZETTE **19**:480. 1894.